

Novel biofilm control measures to prevent corrosion and biofouling in cooling water systems of nuclear power plants

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Climatic changes due to green house gas emissions and substantial increase in the energy costs, demand effective energy management. In this regard the performance of cooling water systems in various power plants to maintain highest electrical energy output per tonne of fuel consumed is particularly important. Despite efforts to provide efficient design of heat exchangers and effective maintenance that involves chlorination and sponge ball cleaning during operation, fouling and corrosion under the influence of microbes and their biofilms is posing a big threat to this objective. Materials used in cooling water systems like copper alloys, microalloyed steels, and titanium can undergo biofouling and subsequent degradation under biofilms. Titanium is chosen as condenser material for the prototype fast breeder reactor at Kalpakkam. To avoid corrosion and biofouling of titanium during service, extensive investigations were carried out by different methods including nanostructuring of surfaces for making them antibacterial. The first step was to reduce the microroughness of titanium by repeated pickling which by itself reduced microbial adhesion. In the second step, anodization of titanium surfaces followed by heat treatment was adopted to control microbial fouling. This was possible as a consequence of photocatalytic activity under visible light illumination of nanoparticles of anatase-rutile combinations produced during anodization. Electroless plating of nanocopper film on titanium surfaces demonstrated good antibacterial activity. Non-conventional techniques like applied potential and ultrasonication was also attempted to control biofilm formation on material surfaces to provide antimicrobial activity. Recently superhydrophobic surface modification is attempted on condenser materials by preparing micro-nano textured surfaces through mechanical and chemical methods, and providing low surface energy dip coatings, for antibacterial activity. The presentation highlights the above results.

Biography

Rani P. George Leader, Surface Modification Programme, in CSTG, since 1991. She is working on corrosion and biofouling of materials in aquatic systems. She has 35 papers in reputed journals and has won several awards including NIGIS Award for Excellence in Corrosion Science and Technology (2010).

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